Division of Extramural Research and Training Fourth Annual Scientific Retreat

The NIEHS Division of Extramural Research and Training held its fourth annual scientific retreat 4–5 December 2003 in Southern Pines, North Carolina. Unlike previous DERT scientific retreats, this meeting revolved around a single topic: systems biology. While it is clear that systems biology offers great power, it is the potential application to the environmental health sciences that interests the NIEHS.

Although experts do not agree entirely on how systems biology should be defined, the NIEHS has adopted a broadly stated definition that represents the integration of multiple data streams into a unified model allowing for quantitative predictions of how a system of interest will respond to various perturbations. The long-range objective for the NIEHS in systems biology is the development of an *in silico* model of the human that will allow quantitative predictions of the risks associated with environmental exposures.

The retreat was divided into three sessions ultimately intended to address the question of how the emerging science of systems biology can be applied in the environmental health sciences. The three sessions were developed such that each built on the foundation of the previous.

Session 1 dealt with the techniques used in systems biology, including a focus on proteomics, metabolomics, and computational analyses. Session 2 consisted of presentations of current applications of systems biology in specific disease states. Session 3 extended this discussion to explore the concept of relating systems-level analyses of diseases to public health issues. The meeting also included keynote addresses on the ethical, legal, and social implications of systems biology and on the potential applications of nano- and microscale technologies for risk assessment.

Invited Speakers

Melvin Andersen, PhD
CIIT Centers for Health Research

Pierre Chaurand, PhD
Vanderbilt University

Charles DeLisi, PhD
Boston University

John Doyle, PhD
California Institute of Technology

Teresa Whei-Mei Fan, PhD
University of Louisville

Thomas Kepler, PhD
Duke University

John Lambris, PhD
University of Pennsylvania

Gary Marchant, PhD, MPP, JD
Arizona State University

Eric Neuman, PhD
Beyond Genomics

Christopher Portier, PhD
NIEHS

David Schwartz, MD, MPH
Duke University

James Swenberg, DVM
University of North Carolina–Chapel Hill

Jennifer Van Eyk, PhD
The Johns Hopkins University

David Walt, PhD
Tufts University

There was considerable enthusiasm for the involvement of the NIEHS in supporting the development of systems biology as a new research paradigm. This approach is quite distinct from the traditional reductionist approach to scientific investigation and offers many potential advantages, most notably through the ability to rapidly make quantitative predictions of system responses. Although current state-of-the-art approaches are sufficient for modeling well-defined pathways, there is a need for continued refinement of both acquisition and analysis tools, which will allow for improved predictions of dynamic systems and integrated models of whole organisms (including, ultimately, the human).

Among the technical needs outlined were improvements in the temporal, spatial, and quantitative resolving power of "-omics" techniques. Another important aspect of developing a systems-level portfolio is support for the development and training of interdisciplinary teams of scientists with enough understanding of each others' areas of specialty to enable them to work together to design a robust approach to systems investigation. Finally, as one attendee noted, "We do not need to be concerned with doing systems biology but rather [with] tackling problems."